

## Contents

|                                 |     |
|---------------------------------|-----|
| <i>Editorial</i> . . . . .      | iii |
| <i>Session Chairs</i> . . . . . | v   |
| <i>Contents</i> . . . . .       | vii |

### SECTION 1: PATHOLOGY AND CARCINOGENESIS

|   |    |
|---|----|
| Phenotypically Altered Hepatocyte Populations in Diethylnitrosamine-Induced Medaka Liver Carcinogenesis: Resistance, Growth, and Fate . . . . . | 1  |
| DAVID E. HINTON, SWEE J. TEH, MARK S. OKIHIRO, JANIS B. COOKE & LYNN M. PARKER (USA)  |    |
| Magnetic Resonance Detection of Environmentally Induced Hepatic Lesions in <i>Fundulus heteroclitus</i> . . . . .                               | 7  |
| GEORGE GASSNER, WOLFGANG VOGELBEIN & MICHAEL LINE (USA)   |    |
| Bromodeoxyuridine Uptake in Hydropic Vacuolation and Neoplasms in Winter Flounder Liver . . . . .   | 13 |
| MICHAEL J. MOORE & JOHN J. STEGEMAN (USA)   |    |
| Elevated Ornithine Decarboxylase Activity in Winter Flounder Livers Exhibiting Cellular Lesions . . . . .                                       | 19 |
| ROBERT A. KOZA, MICHAEL J. MOORE & JOHN J. STEGEMAN (USA)   |    |
| Pollutant-Induced Cell Injury in Fish Liver: Use of Fluorescent Molecular Probes in Live Hepatocytes . . . . .                                  | 25 |
| MICHAEL N. MOORE (UK)   |    |

|  |    |
|--|----|
| Detection of <i>ras</i> Oncoprotein in Liver Cells of Flatfish (Dab) from a Contaminated Site in the North Sea . . . . .                             | 33 |
| MICHAEL N. MOORE & BARRY EVANS (UK)  |    |
| Histopathological Changes in the Liver of Dab ( <i>Limanda limanda</i> ) from a Contamination Gradient in the North Sea . . . . .                    | 39 |
| MICHAEL G. SIMPSON (UK)  |    |
| Hepatic Lesions Other than Neoplasms in Subadult Flatfish from Puget Sound, Washington: Relationships with Indices of Contaminant Exposure . . . . . | 45 |
| MARK S. MYERS, O. PAUL OLSON, LYNDAL L. JOHNSON, CARLA S. STEHR, TOM HOM & USHA VARANASI (USA)   |    |
| Chromatophoromas and Related Hyperplastic Lesions in Pacific Rockfish ( <i>Sebastes</i> spp.) . . . . .  | 53 |
| M. S. OKIHIRO, J. A. WHIPPLE, J. M. GROFF & D. E. HINTON (USA)   |    |
| Chemical Induction of Tumours in Oysters by a Mixture of Aromatic and Chlorinated Hydrocarbons, Amines and Metals . . . . .                          | 59 |
| GEORGE R. GARDNER, RICHARD J. PRUELL & A. RUSSELL MALCOLM (USA)  |    |
| Histopathological Alterations in <i>Mya arenaria</i> Following a #2 Fuel Oil Spill in the Arthur Kill, Elizabeth, New Jersey . . . . .               | 65 |
| R. P. BROWN, A. CRISTINI & K. R. COOPER (USA)  |    |
| Lectin Binding Sites in the Digestive Gland of Mussel . . . . .  | 69 |
| JOANNE M. THORNDIKE, P. H. BACH & M. N. MOORE (UK)   |    |
| Age-Related Differences in the Recovery of Lysosomes from Stress-Induced Pathological Reactions in Marine Mussels . . . . .                          | 75 |
| LISA M. HOLE, MICHAEL N. MOORE & DENIS BELLAMY (UK)  |    |
| Studies of a Fatal Pollutant-Induced Hyperbilirubinaemia in Spawning Atlantic Salmon . . . . .   | 81 |
| STEPHEN G. GEORGE (UK), D. GROMAN (Canada), S. BROWN & K. HOLMES (UK)  |    |

## SECTION 2: CYTOCHROME P450 REGULATION

- The Ah Receptor in Marine Animals: Phylogenetic Distribution and Relationship to Cytochrome P4501A Inducibility . . . 87  
MARK E. HAHN, ALAN POLAND, ED GLOVER & JOHN J. STEGEMAN (USA)
- Potential of  $\beta$ NF Induction of Cytochrome P4501A1 by Glucocorticoids in Primary Culture of Rainbow Trout Hepatocytes . . . 93  
ALAIN DEVAUX (France), MAIJA PESONEN (Sweden), GILLES MONOD (France) & TOMMY ANDERSSON (Sweden)
- Endogenously-Mediated, Pretranslational Suppression of Cytochrome P4501A in PCB-Contaminated Flounder . . . 97  
ADRIA A. ELSKUS, RICHARD PRUELL & JOHN J. STEGEMAN (USA)
- Effects of Prior Exposure History on Cytochrome P4501A mRNA Induction by PCB Congener 77 in Atlantic Tomcod . . . 103  
ISAAC I. WIRGIN, GUAT-LIAN KREAMER, CHERYL GRUNWALD, KATHERINE SQUIBB, SEYMOUR J. GARTE (USA) & SIMON COURTENAY (Canada)
- Purification, Characterization and Regulation of a Male-Specific Cytochrome P450 in the Rainbow Trout Kidney . . . 109  
TOMMY ANDERSSON (Sweden)
- Cytochrome P450 in Seals: Monooxygenase Activities, Immunochemical Cross-Reactions and Response to Phenobarbital Treatment . . . 113  
ANDERS GOKSØYR, JONNY BEYER, HÅVARD E. LARSEN (Norway), TOMMY ANDERSSON & LARS FÖRLIN (Sweden)
- Immunocytochemical Localization of Cytochrome P4501A1 in Liver of Rainbow Trout (*Oncorhynchus mykiss*) . . . 117  
SUSAN M. LESTER (USA), THOMAS A. BRAUNBECK (Germany), SWEE J. TEH, JOHN J. STEGEMAN, MICHAEL R. MILLER & DAVID E. HINTON (USA)
- Quantification of Cytochrome P4501A1 and Catalytic Activities in Liver Microsomes of Isosafrol- and  $\beta$ -Naphthoflavone-treated Rainbow Trout (*Oncorhynchus mykiss*) . . . 123  
MALIN CELANDER & LARS FÖRLIN (Sweden)

|  |     |
|--|-----|
| Influence of Dietary PUFA Content on Cytochrome P450 and Transferase Activities in Atlantic Salmon ( <i>Salmo salar</i> ) . . .      | 127 |
| STEPHEN GEORGE & JAMES HENDERSON (UK)  |     |
| SECTION 3: ENVIRONMENTAL MONITORING WITH CYTOCHROME P450   |     |
| Nomenclature for Hydrocarbon-Inducible Cytochrome P450 in Fish . . .   | 133 |
| JOHN J. STEGEMAN (USA)   |     |
| CYP1A1 Protein and mRNA in Teleosts as an Environmental Bioindicator: Laboratory and Environmental Studies . . .                     | 139 |
| MARY L. HAASCH, ELLEN M. QUARDOKUS, LESLIE A. SUTHERLAND, MARK S. GOODRICH, RUTH PRINCE, KEITH R. COOPER & JOHN J. LECH (USA)        |     |
| The Cytochrome P450 1A1 Response in Fish: Application of Immunodetection in Environmental Monitoring and Toxicological Testing . . . | 147 |
| ANDERS GOKSØYR & ASTRID-METTE HUSØY (Norway)   |     |
| The Utilization of Cytochrome P4501A mRNA in <i>Limanda limanda</i> (Dab) as a Monitor of Chemical Exposure in the North Sea . . .   | 151 |
| KENNETH W. RENTON & RICHARD F. ADDISON (Canada)  |     |
| Unbleached Pulp Mill Effluents Affect Cytochrome P450 Monooxygenase Enzyme Activities . . .  | 157 |
| PIRJO LINDSTRÖM-SEPPÄ, SIRPA HUUSKONEN, MAIJA PESONEN, PAULA MUONA & OSMO HÄNNINEN (Finland)   |     |
| Bioindicator Field Monitoring: Use of Fish Biochemical Parameters at a Modern Bleached Kraft Pulp Mill Site . . .                    | 163 |
| PAMELA KLOEPPER-SAMS (USA) & STELLA SWANSON (Canada)   |     |
| Biotransformation Enzyme Activities and PCDD/PCDF Levels in Pike Caught in a Swedish Lake . . .                                      | 169 |
| LARS FÖRLIN, LENNART BALK, MALIN CELANDER, STURE BERGEK, MARIA HJELT, CHRISTOFFER RAPPE, CYNTHIA DE WIT & BO JANSSON (Sweden)        |     |
| Applications of Hepatic Mixed Function Oxidase Enzyme Activities to Northern Freshwater Fish: I. Burbot, <i>Lota lota</i> . . .      | 175 |
| W. L. LOCKHART & D. A. METNER (Canada)   |     |

|   |     |
|---|-----|
| The Use of Polyclonal Antibodies Raised against Rat and Trout Cytochrome P450 CYP1A1 Orthologues to Monitor Environmental Induction in the Channel Catfish ( <i>Ictalurus punctatus</i> ) . . . . .                                   | 181 |
| M. J. J. RONIS (USA), MALIN CELANDER, LARS FÖRLIN (Sweden) & THOMAS M. BADGER (USA)   |     |
| Hepatic EROD Activity in Spot, <i>Leiostomus xanthurus</i> , Exposed to Creosote-Contaminated Sediments . . . . .   | 189 |
| DANIEL W. SVED, PETER A. VAN VELD & MORRIS H. ROBERTS, JR (USA)   |     |
| Using Cytochrome P450 to Monitor the Aquatic Environment: Initial Results from Regional and National Surveys . . . . .  | 195 |
| TRACY K. COLLIER, S. DENISE CONNOR, BICH-THUY L. EBERHART, BERNADITA F. ANULACION (USA), ANDERS GOKSØYR (Norway) & USHA VARANASI (USA)  |     |
| Mixed Function Oxidase Activity and Chlorinated Hydrocarbon Residues in Antarctic Sea Birds: South Polar Skua ( <i>Catharacta maccormicki</i> ) and Adélie Penguin ( <i>Pygoscelis adeliae</i> ) . . . . .                            | 201 |
| SILVANO FOCARDI, M. C. FOSSI, C. LEONZIO, L. LARI, L. MARSILI (Italy), G. S. COURT & L. S. DAVIS (New Zealand)  |     |
| The Effect of 3,3',4,4'-Tetrachlorobiphenyl and Clophen A50 on the Hepatic Monooxygenase System of Eider Ducklings ( <i>Somateria mollissima</i> ) with Indications for Structure-Related Biotransformation of CB Congeners . . . . . | 207 |
| M. J. C. ROZEMEIJER, J. P. BOON, P. DUIVEN, J. VAN DER MEER, J. S. J. VAN DE SANT, C. SWENNEN, A. J. MURK, J. H. J. VAN DEN BERG, M. FELLINGER, A. BROUWER & J. H. KOEMAN (The Netherlands)   |     |
| Effects of 2,3,7,8-TCDD and Contaminated Sediment on the Cytochrome P4501A Orthologue in Rainbow Trout ( <i>Oncorhynchus mykiss</i> ) and Carp ( <i>Cyprinus Carpio</i> ), Using Catalytic and Immunochemical Techniques . . . . .    | 215 |
| MARTINE E. J. VAN DER WEIDEN (The Netherlands), MALIN CELANDER (Sweden), WILLEM SEINEN, MARTIN VAN DEN BERG (The Netherlands), ANDERS GOKSØYR (Norway) & LARS FÖRLIN (Sweden)   |     |

## SECTION 4: PHASE II METABOLISM

- Glutathione-Mediated Chlorothalonil Detoxification in Channel Catfish Gills . . . . . 221  
 EVAN P. GALLAGHER & RICHARD T. DI GIULIO (USA)
- The Effect of  $\beta$ -Naphthoflavone and Phenobarbital on UDP Glucuronosyltransferase in King Salmon (*Oncorhynchus tshawytscha*) . . . . . 227  
 REESE A. BOLINGER & JOHN M. KENNISH (USA)
- Regulation of Hepatic Glutathione S-Transferase Expression in Flounder . . . . . 233  
 KAREN SCOTT, MICHAEL J. LEAVER & STEPHEN G. GEORGE (UK)
- Expression and Tissue Distribution of Plaice Glutathione S-Transferase A . . . . . 237  
 MICHAEL J. LEAVER, KAREN SCOTT & STEPHEN G. GEORGE (UK)
- Glutathione S-Transferase from an Antarctic Fish, *Dissostichus mawsoni* . . . . . 243  
 K. CAMERON FALKNER & ALAN G. CLARK (New Zealand)

## SECTION 5: BIOTRANSFORMATION, PHARMACOKINETICS AND TOXICITY

- The Multidrug Resistance-Like Mechanism in the Marine Sponge *Tethya aurantium* . . . . . 249  
 BRANKO KURELEC & BRANKA PIVČEVIĆ (Croatia)
- Disposition and Metabolism of 2,3,7,8-Tetrachlorodibenzofuran (TCDF) in Rainbow Trout . . . . . 255  
 ROBERT MASLANKA, A. RUTH STEWARD, JYOTSNA PANEREKAR, SUBODH KUMAR & HARISH C. SIKKA (USA)
- Metabolic Alterations of PCB Residues in Aquatic Fauna: Distributions of Cytochrome P4501A1- and P4502B-Like Activities . . . . . 261  
 JOHN F. BROWN JR (USA)

|   |     |
|---|-----|
| Indications of P450 Monooxygenase Activities in Beluga ( <i>Delphinapterus leucas</i> ) and Narwhal ( <i>Monodon monoceros</i> ) from Patterns of PCB, PCDD and PCDF Accumulation . . . . .   | 267 |
| R. J. NORSTROM, D. C. G. MUIR, C. A. FORD, M. SIMON,<br>C. R. MACDONALD & P. BÉLAND (Canada)  |     |
| Microsomal Activation of Benzo[a]pyrene to Mutagens by <i>Alligator mississippiensis</i> In Vitro: Induction by 3-Methyl-cholanthrene . . .   | 273 |
| MILES A. KIRCHIN & GARY W. WINSTON (USA)  |     |
| In-Vitro Metabolism of Benzo[a]pyrene and Benzo[a]pyrene-7,8-Dihydrodiol by Liver and Intestinal Mucosa Homogenates from the Winter Flounder ( <i>Pseudopleuronectes americanus</i> ) . . . . | 279 |
| ANNE E. MCELROY & KEVIN M. KLEINOW (USA)  |     |
| Xenobiotic Metabolizing Enzyme Activity in the Liver and Kidney of the Brown Bullhead ( <i>Ictalurus nebulosus</i> ) . . . . .  | 287 |
| JYOTSNA PANGREKAR & HARISH C. SIKKA (USA)   |     |
| Xenobiotic Metabolizing Enzyme Activity in Sockeye Salmon ( <i>Oncorhynchus nerka</i> ) during Spawning Migration . . . . .   | 293 |
| JOHN M. KENNISH, REESE A. BOLINGER, KENT A.<br>CHAMBERS & MELINDA L. RUSSELL (USA)  |     |
| Dose- and Time-Dependent Formation of Benzo[a]pyrene Metabolite DNA Adducts in the Spiny Lobster, <i>Panulirus argus</i> . . . . .  | 299 |
| MARGARET O. JAMES, ALLEN H. ALTMAN, CHUNG-LI J. LI &<br>SEAN M. BOYLE (USA)   |     |
| Metabolism and Mutagenicity of 4-Nitroquinoline N-Oxide by Microsomes and Cytosol of Digestive Gland of the Mussel <i>Mytilus edulis</i> L. . . . .   | 303 |
| PAZ GARCIA-MARTINEZ (Spain), ANTAL K. D. HAJOS (USA),<br>DAVID R. LIVINGSTONE (UK) & GARY W. WINSTON (USA)  |     |
| Further Characterization of Benzo[a]pyrene Metabolism in the Sea Star, <i>Asterias rubens</i> L. . . . .  | 309 |
| PIETER J. DEN BESTEN (The Netherlands), SEAN C. M. O'HARA<br>& DAVID R. LIVINGSTONE (UK)  |     |
| The Role of Oxyradicals in Intracellular Proteolysis and Toxicity in Mussels . . . . .  | 315 |
| MILES A. KIRCHIN, MICHAEL N. MOORE, ROGER T. DEAN<br>(UK) & GARY W. WINSTON (USA)   |     |

|   |     |
|---|-----|
| A Physiologically Based Pharmacokinetic Model for <i>Mya arenaria</i><br>M. D. MORENO, K. R. COOPER, R. P. BROWN & P.<br>GEORGOPOULOS (USA)   | 321 |
| Effects of Organic Toxicants on the Anoxic Energy Metabolism<br>of the Mussel <i>Mytilus edulis</i><br>W. X. WANG, J. WIDDOWS (UK) & D. S. PAGE (USA)   | 327 |
| Polynuclear Aromatic Hydrocarbons and Fish Lens Cataract:<br>Effects of Benzo[a]pyrene-7,8-Dihydrodiol on the Macro-<br>molecular Synthesis of Cultured Eye Cells<br>CHRISTOPHER D. WILLIAMS, MOHAMED FAISAL & ROBERT J.<br>HUGGETT (USA) | 333 |
| Requirement of Endogenous Iron for Cytotoxicity Caused by<br>Hydrogen Peroxide in <i>Euglena gracilis</i><br>KIMETTE RADTKE, ROBERT W. BYRNES, PAMELA KERRIGAN,<br>WILLIAM E. ANTHOLINE & DAVID H. PETERING (USA)                         | 339 |
| A Model for the Cytotoxic Effects of Amphiphilic Chemicals in<br>Marine Organisms Using 3T3-Cells<br>JOANNE M. THORNDIKE, P. H. BACH & M. N. MOORE (UK)   | 345 |
| 7-Ethylresorufin O-Deethylase Activity and Level of DNA-<br>Adducts in Trout Treated with Benzo(a)pyrene<br>JEAN-FRANÇOIS MASFARAUD, ANNIE PFOHL-LESZKOWIC,<br>CHRISTIAN MALAVEILLE, GÉRARD KEITH & GILLES MONOD<br>(France)              | 351 |



